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Abstract

The Melogno pass ("Colle del Melogno") is located at 1026 m above sea level, between the high Val Bormida and the hinterland of the Finalese (province of Savona) and is one of the highest mountain passes in the Ligurian Alps. In ancient times, this zone was considered strategically important from the military point of view since it is located at the crossroads of many communication routes. In these areas, in November 1795, during the "Battle of Loano", the French army, commanded by Andrea Massena and the allied army of Austria, prevailed over the Kingdom of Sardinia, led by Oliver Remigius von Wallis. However, the territory remained possession of the Kingdom of Sardinia and, between 1883 and 1895, the worsening of relations with France induced the government to erect, near the pass, three imposing fortifications (Tortagna, Settepani and Centrale) to prevent an entry into Piedmont by armies coming from the coast. For the same purpose other fortifications were erected near the passes of Tenda, Nava, Turchino and near the villages of Zuccarello, Altare and Vado. The most impressive among the three fortifications of Melogno pass is the Central Fort. It occupies all the saddle of the pass and it is crossed by the provincial road 490 connecting the coast of Finale Ligure to Piedmont. The fort, still of military property, is a listed historical artefact. It has a polygonal shape, with a main barrack developed on two floors. Four defensive and attacking emplacements were located outside the main complex, along a detached hill, with heavy artillery pointed towards the coast. The study will examine the natural and artificial stone materials used for the building through mineralogical and petrographic analysis and will verify both the variations occurred during the construction phases and the relations with the local supply sources.

Keywords: Savoy fortifications, Liguria, building materials.

1. Introduction

The Finale territory, in the province of Savona (Liguria, Italy), is located in a strategically relevant area. In fact, it is characterized by the presence of important communication routes that connect the territories of the Ligurian coast with Piedmont. There were three historical routes that guaranteed the connection between Finale and the northern side of the Ligurian Alps. Among these, there is the Melogno road (the 490 provincial road) connecting, now as in the past Finale Ligure to Calizzano, from where it is possible to reach the Bormida valley and the Tanaro one.

The road has numerous fortified constructions placed in defence of the road. Some of them date back to the Renaissance period and their presence is attested both by the cartography produced from the eighteenth century to the nineteenth century, and by the existence of traces and physical testimonies, recently recognized thanks to a capillary archaeological reading, supported by a careful analysis of archival, graphic and cartographic documentation conducted by Gianfranco Pertot (Pertot, 2018).

At the end of the nineteenth century, following the signing of the Triple Alliance pact (1882), it was necessary to strengthen the defences along the Italian-French border and the territories bordering with Liguria. Therefore, new fortifications were added[1]. In particular, starting from 1883, three forts were built: the Central Fort, located at the Melogno pass; the Tortagna Fort on the slopes of the Bric Merizzo and the Settepani Fort on the top of the mountain of the same name (Figs. 1 and 2).

Fig. 1. The position of Melogno Fort in Liguria (after Google Earth, modified).

Fig. 2. The three forts at defence of the French-Italian border (after Google Earth, modified).

This contribution focuses on the analysis of materials and construction techniques of the Central Fort. The study wants to highlight both the close link between the architectural artefact and the locally available materials, and the conservation problems that characterize this interesting historical architectural testimony.

2. The Central Fort: construction features and conservation issues

The Central Fort belongs to the type of barrier forts. It was built on the road that crosses the pass. In the event of an attack, it was entrusted with the task of blocking the access to enemy troops, while the protection batteries, located in the surrounding hills, guaranteed the protection of the fort keeping the opposing artillery at a distance.

The building has a polygonal plan and occupies the entire saddle of the pass (Fig. 3). It is surrounded by a ditch "defended by caponiers and cross bonnets" (Minola, Ronco, 2006, p. 120) and has a barrack at the northern front. It "had a main order of fire, with artillery arranged in a beard directed eastward and toward the upper portion of the deep valleys that descend towards the coast, and an order of fire in a casemate aimed at beating the route of the access roadway" (Minola, Ronco, 2006, p. 120).

Fig. 3. The Melogno Central Fort in an old postcard (Mario Berruti).

The road crosses the fort with a tunnel. In correspondence with its accesses, there are two stone portals, preceded by bridges –originally movable– overcoming the moat. The same lithotype present in the accesses to the tunnel is in the corner headboards and in the frames of the openings on the north-west and south-east side (Figs. 4-6). The masonry face of the fort is instead made of irregular cut ashlars belonging to a different lithotype and can be classified as uncoursed random rubble masonry (Fig. 6). On the main side, facing south west, there is a double order of openings with brick frames (Fig. 7). The covering is shielded by an earth layer on which a thick vegetation has grown.

Fig. 4. The access to the tunnel (Fratini).

Fig. 5. The corner headboards (Mattone).

Fig. 6. The frames of the openings (Mattone).

The Central Fort never suffered attacks from enemies; during the First World War, it was deprived of the artillery which was employed in other fronts. It has not been used for a long time and now it is completely abandoned; a similar situation characterises the barracks located a short distance away on the Piedmont side. The fort was subjected only to a few punctual interventions aimed at precluding access to the building and limiting the detachment of the plaster of the vaulted structures overlooking the road.

Fig. 7. Double order of openings with brick frames (Fratini).

3. Materials and methods

From the external masonry of the fort the following materials have been taken:

- angular ashlars and ashlars present in the frames of some openings;

- irregular cut ashlars of the walls;

- bricks located in the frames of some openings and in the jambs inside the tunnel;

- bedding mortars of the walls;

- plasters mortars present inside the tunnel that crosses the fort;

These materials have been characterized from the mineralogical and petrographic point of view with the following analytical methods:

- mineralogical analysis with a PANalytical diffractometer X'PertPRO with radiation $CuK\alpha1$ = 1,545˚A, operating at 40 KV, 30 mA, investigated range 2θ = 3-70°, equipped with X'Celerator multirevelatory and High Score data acquisition and interpretation software so as to determine the mineralogical composition;

- optical microscopy in transmitted light was performed on thin sections (30 microns' thickness) with a polarised light microscope (ZEISS Axioscope. A1).

4. Results

As mentioned, the macroscopic observation of the masonry allowed us to recognize two lithotypes, the one with which the angular ashlars and other architectural elements were made and the one characterising the walls. The first has a greyish colour and a coarse grain (Fig. 8). The petrographic study allowed us to recognize a porphyritic structure with phenocrysts of Kfeldspar, quartz, plagioclase, orneblende and biotite. The matrix is completely crystallized and phenomena of feldspar albitization and transformation of the biotite into chlorite and magnetite are visible (Fig. 9).

Fig. 8. The angular ashlars (Fratini).

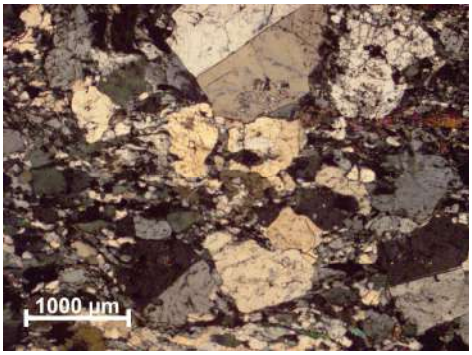

Fig. 9. The angular ashlars (image at the optical microscope in thin section, polarised light), (Rescic).

This lithotype can be referred to the formation of the "Porphyroids of the Melogno"-riodacites lithozone (**PDMb** of the Geological Map of Italy 1:50000, Sheet 228-Cairo Montenotte). These are rhyodacitic ignimbrites, followed by rhyolites and dacites. These rocks, of lower Permian age, underwent a metamorphism during the alpine orogenesis that determined a general recrystallization in the albite-epidote facies with formation of a schistosity S1 evidenced by the flattening and stretching of the phenocrysts.

For the ashlars of the masonries, a light grey to whitish and light green colour lithotype was instead used, often with presence of rusty patinas, set up parallel to the schistosity (Fig. 10). The petrographic study has allowed us to recognize a very fine homogeneous texture weakly to markedly oriented, with grains made of quartz and secondarily by micas with rare quartz and feldspars phenocrysts often stretched (Fig. 11).

Fig. 10. The ashlars of the masonries (Fratini).

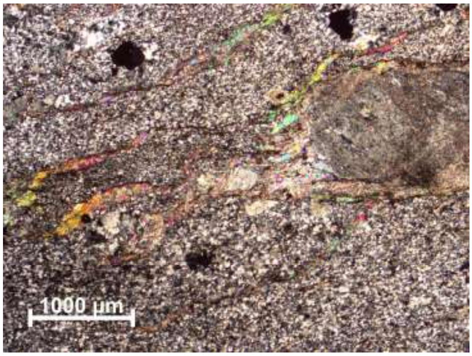

Fig. 11. The ashlars of the masonries (image at the optical microscope in thin section, polarised light), (Rescic).

These rock can be classified as quartzites and quartz-micaschists. These lithotypes, according to the Geological Map of Italy 1:100000 (Sheet 92-93 Albenga-Savona) can be found in different levels both within the "Scisti di Gorra" (**GRR** of the Geological Map of Italy 1:50000, Sheet 228-Cairo Montenotte) and within the formation of "Porfiroidi del Melogno" (calcoalacaline lithozone - **PDMc**). Also these rocks, of lower Permian age, underwent a metamorphism during the alpine orogenesis that determined a general recrystallization in albite-epidote facies.

Both lithotypes crop out near the pass and exhibit excellent resistance to decay. The selection of these lithotypes for these two different uses seems to be mainly due to aesthetic reasons. However, the use of the coarse porphyritic rocks for angular ashlars and of the quartzites for the whole of the walls may be due to practical reasons too. In fact, thanks to the more evident schistosity, these could be easily broken obtaining suitable flat surfaces while the porphyritic rocks could be more easily worked and shaped in regular ashlars of large dimensions thanks to the less pronounced schistosity.

With regard to bedding mortars, we can distinguish two main types. The first one can be found in the external stone masonry and it is characterized by a particularly lean mixture with a calcic-lime binder and an aggregate consisting of subrounded grains whose nature reflects that of the local geology. In fact, there are fragments of quartzites, micaschists, crystalline carbonate rocks and single grains of quartz and feldspars. The granulometry is bimodal with prevalence of the fine fraction with dimensions < 1 mm (Fig. 12).

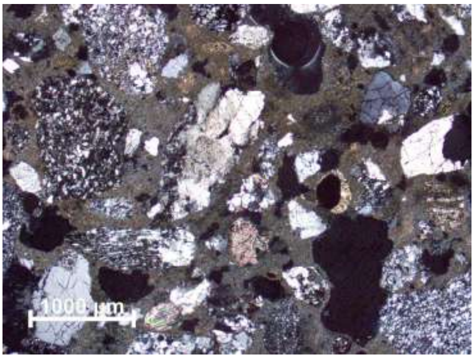

Fig. 12. Bedding mortar of the external stone masonry characterized by a particularly lean mixture (image at the optical microscope in thin section, polarised light), (Rescic).

A second typology is the one used to set the bricks that constitute the frames of the openings and it is generally characterized by a fat mixture with a calcic-lime binder and an aggregate with grains angular in shape made of quartz, feldspar and crushed bricks (Fig. 13)

With regard to the renders present in the tunnel, they are characterized by a mixture of a quite abundant calcic lime-based binder and an aggregate in which often a very fine grain fraction (150-200 µm) consisting of quartz and feldspars prevails (Fig. 14).

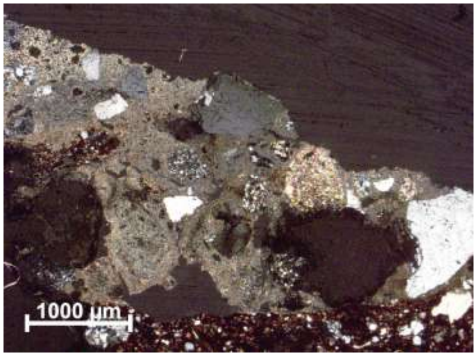

Fig. 13. Bedding mortar of the bricks of the frames, characterized by a fat mixture (image at the optical microscope in thin section, polarised light), (Rescic).

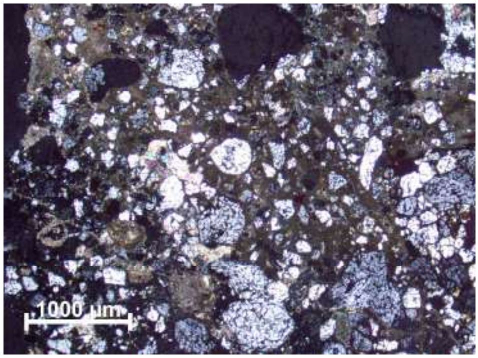

Fig. 14. Mortar of the renders of the tunnel: the fraction of aggregate with very fine granulometry is evident (image at the optical microscope in thin section, polarised light), (Rescic).

With regard to bricks, it is possible to recognize two main types. The first, used in the internal jambs of the tunnel, is characterized by a bright red colour. Microscopically it shows an abundant framework of fine granulometry (30-50µm) composed of quartz, feldspar and micas with an opaque homogeneous groundmass (Fig. 15, 16). The second type, used in the frame of the openings, has an orange-red colour with an abundant framework of coarser granulometry (500-600µm) made of quartz, feldspar and micas with a groundmass characterized by the presence of neoformation crystals referable to calcium silicates as evidenced by XRD analysis (Figs. 17 and 18).

Fig. 15. Bricks of the internal jambs of the tunnel (Fratini).

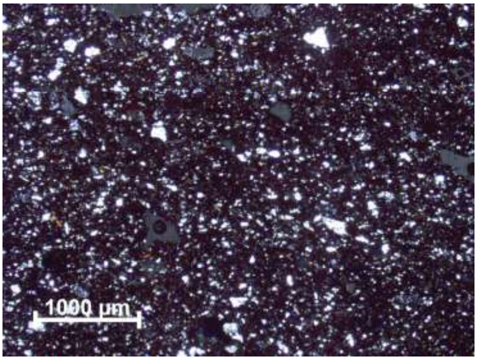

Fig 16. Bricks of the internal jambs of the tunnel (image at the optical microscope in thin section, polarised light), (Rescic).

Fig. 17. Bricks of the frame of the openings (Fratini).

The presence of these two types of bricks therefore derives from the use of two different raw materials: in the first case a silty clay poor in carbonates and in the second case a sandy clay, rich in carbonates.

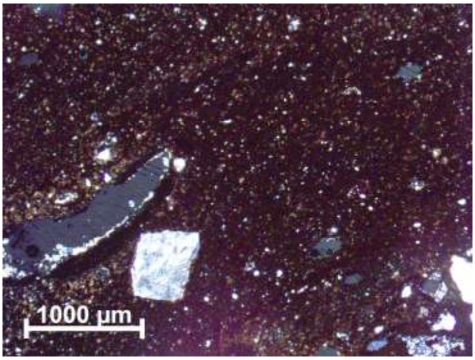

Fig. 18. Bricks of the frame of the openings (image at the optical microscope in thin section, polarised light), (Rescic).

5. Conclusions

The study of the building stone materials of the Melogno Central Fort to highlight the close link with the stone resources of the territory. Furthermore, it is interesting to observe the attention payed in the selection of these materials: massive porphyritic rocks for the construction of large angular blocks while quartzites were adopted to cover the core walls with flat surfaces.

With regard to mortars, the use of different mixtures for the various functions is evident (bedding of stone ashlars, bedding of the brick frames, renders). Also in this case we note the link with the resources of the territory: the aggregate comes from the sediments of the local streams and the lime from the firing of local limestones.

As for the state of conservation, the three fortress of the Melogno pass have suffered a different fate. Tortagna Fort is private and has recently been completely restored. Settepani Fort hosts a military base fallen into disuse and is not accessible. The Central Fort, even though interesting testimony to the history of the Country, is abandoned and up to now has not undergone any intervention of protection and promotion. The lack of use has determined the progressive depletion of this cultural resource, destined to a rapid decline. It is therefore important to become promoters of studies aimed at "multiplying the angles and the intensity of observation [together with the] possible horizons of interest" (Pertot, 2018). In fact, knowledge is the first step of a methodology for the design of preservation interventions. Moreover, similarly to what has already occurred for other defensive structures located in the Ligurian territory[2], it is necessary to develop projects for the enhancement and re-use of these assets with the dual aim of guaranteeing their conservation over time and promoting the economic development of the territories to which they belong.

Notes

[1] The Permanent Commission for the Defence of the State considered it necessary to proceed with the construction of a defensive array along the Ligurian Alps, useful as a "defence and support base for counteroffensive operations in the Riviera di Ponente" (Minola, Ronco, 2006, p. 120).

[2] With reference to the "Liguria Heritage", a project of promotion of the natural and cultural heritage of Liguria (Asse 4 del POR FESR 2007-2013). *La Liguria, terra di forti. La difesa della Repubblica, la difesa del Regno Sabaudo*, in www.liguriaheritage.it (3 September 2019).

Paragraphs 1; 2; 5 were written by Manuela Mattone. Paragraphs 3; 4; 5 were written by Fabio Fratini and Silvia Rescic.

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